
PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Second Tier Database Support For Ecosystem Focus

BPA project number: 9601900
Contract renewal date (mm/yyyy): 10/2000 ☐ Multiple actions?

Business name of agency, institution or organization requesting funding
Bonneville Power Administration

Business acronym (if appropriate) BPA-EWI

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NPPC Program Measure Number(s) which this project addresses
3.2G, 5.0F.5

FWS/NMFS Biological Opinion Number(s) which this project addresses
NMFS 1995 BiOp Actions IIA, IIB, IIC, IID; RPAs 13 (pg 119), 16 (pg 123), 17 (pg 124) and ITS's;
NMFS 1998 Supplemental Steelhead BiOp; and all other BiOps and associated RPA's and ITS's pertaining
to the Federal Columbia River Power System

Other planning document references

Short description

Implement certain non-discretionary actions to provide single-point, Internet-based access to a subset of information to guide and support BPA's independent decisions pertaining to its responsibilities under the Power Act and Endangered Species Act

Target species

Anadromous and resident fishes of the Columbia-Snake River Basin

Section 2. Sorting and evaluation

Subbasin

Systemwide

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
<input checked="" type="checkbox"/> Anadromous fish <input type="checkbox"/> Resident fish <input type="checkbox"/> Wildlife	<input type="checkbox"/> Multi-year (milestone-based evaluation) <input type="checkbox"/> Watershed project evaluation	<input type="checkbox"/> Watershed councils/model watersheds <input checked="" type="checkbox"/> Information dissemination <input type="checkbox"/> Operation & maintenance <input type="checkbox"/> New construction <input checked="" type="checkbox"/> Research & monitoring <input checked="" type="checkbox"/> Implementation & management <input type="checkbox"/> Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description
20537	Bonneville Power Administration Non-Discretionary Projects
9303701	Technical Assistance with Life Cycle Modeling - Paulsen Environmental
9601700	Provide Technical Support in PATH - BioAnalysts Inc. (Giorgi)
9800100	Analytical Support-PATH and ESA Biological Assessments - Hinrichsen Envir
9700200	PATH - UW Technical Support - Columbia Basis Research
9800600	Technical Support to PATH - Anderson Consulting
8910800	Monitoring and Evaluation Modeling Support - Columbia Basin Research
9105100	Monitoring and Evaluation Statistical Support for Life-Cycle Studies-UW
9601900	Second-Tier Database Support for Ecosystem Focus - BPA

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
8910800	Monitoring and Evaluation Modeling Support - Columbia Basin Research	Critical - 8910800's CRISP juvenile salmon hydrosystem survival model requires input presently available only through 9601900 services. Model is used during migration season in support of weekly hydrosystem operations.
9105100	Monitoring and Evaluation Statistical Support for Life-Cycle Studies-UW	Critical - 9105100's "RealTime" statistical juvenile salmon migration timing models require input presently only available from 9601900 services. Models are used during migration season in support of weekly hydrosystem operations.
8910700	Statistical Support for Salmonid Survival Studies - UW (Skalski)	Critical - 9601900 integrates regionally-distributed data for input to 8910700 survival analyses.
8810804	StreamNet: The Northwest Aquatic Information Network	Complimentary - bridges between FPC and StreamNet; improves access, integration and display of inseason and historical information.

9403300	Fish Passage Center	Complimentary - improves access, integration and display of current season FPC smolt monitoring information. Provides online access to prior years FPC information. Critical - FPC is primary data source for current year smolt monitoring data.
9008000	Columbia Basin PIT-Tag Information System	Complimentary - reduces user impacts to PITAGIS, improves access, integration, and display. Critical - PITAGIS is primary data source for PIT tag data.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1995	Developed prototype Data Access in Real Time (DART) and Battelle Technical Management Team World Wide Web services	Operational, river conditions, and fishery observations remain online with administrative record for Technical Management Team for consideration and application in adaptive management practices.
1996	Added PIT-tagged juvenile salmon migration timing forecasts to Lower Granite Dam (program RealTime)	Provide ESU migration timing forecasts for consideration in inseason FCRPS operational planning
1996	Added juvenile salmon migration timing and survival from Lower Granite Dam to the estuary (program CRISP)	Provide ESU migration timing and survival forecasts for consideration in inseason FCRPS operational planning
1997	Battelle Technical Management Team World Wide Web prototype adopted by Corps of Engineers to support TMT	
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided access to information permitting independent evaluation of issues and decision support for inseason operational decisions. 122,169 data queries and 87,834 html documents served Jan-Nov 1998 via Data Access in Real Time (DART).
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	March 1998, BPA and the Corps of Engineers reported to the National Performance Review on "Decision Support and the Management of the Columbia River for Hydro-electrical Power Generation and Endangered Species".
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided input data sets for daily in-season predictions of run-timing of wild yearling and subyearling chinook and sockeye smolts at LWG with results available via World Wide Web to TMT and fisheries community. (RealTime Program)
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided input data sets for weekly predictions of run-timing and survival of ESU runs and populations of interest from

		LWG to below BON with results available via World Wide Web to TMT and fisheries community. (CRiSP Program)
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided input data sets for statistical support for the design and analytical methods of PSMFC/WDFW project "Monitoring pinniped predation on the threatened and endangered salmonids of Washington"
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided input data sets for analysis of historical salmonid smolt radiotelemetry data and statistical methods to improve spring 1999 smolt radiotelemetry studies
1998	Supported independent governmental decisions pertaining to near-term (e.g. inseason) planning and operation of the FCRPS	Provided data management services for 3-year investigation of ocean survival rates of WA coho.
1998	Supported independent governmental decisions pertaining to long-term planning (e.g. PATH) of the configuration and operation of the FCRPS	Provided data management services permitting expanded scope/depth of issues addressed via non-discretionary increase in PATH funding level above amount recommended by CBFWA

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Provide access to data and analytical tools permitting independent evaluation of issues and decision support for inseason operational decisions.	a	Encourage improved FWP information management services through incorporation of prototyped tools and services
1		b	Provide data management and web support to independent analyses that inform BPA management and inseason management participants of inseason conditions and alternative actions.
1		c	Continue development of improved methods of accessing and displaying regional information to assist all inseason management participants.
2	Provide access to data and analytical tools permitting independent evaluation of issues and decision support for long-term planning.	a	Provide data management and web support to independent evaluations of consensus PATH work products.
2		b	Provide data management and web support for the development of PATH work products that are not addressed in the consensus process but which BPA believes necessary for responsible decisions.
3	Restructure governmental services to provide public access to environmental information and effective information tools to decision makers (Executive Order Order 13011 - "Federal	a	Support development of World Wide Web based information services and their incorporation by technical and political processes involving federal resources and decisions.

	Information Technology")		

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	10/1999	9/2000	Improve and provide access to ecological information pertinent to inseason operations of the FCRPS and survival of affected species		
2	10/1999	9/2000	Improve and provide access to ecological information pertinent to inseason operations of the FCRPS and long-term survival and recovery of affected species		
3	10/1999	9/2000			
				Total	0.00%

Schedule constraints

Inseason support services must be online prior to April 1.

Completion date

Section 5. Budget

FY99 project budget (BPA obligated):

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	18.5 man-months for partial-year employment of database administration, web and system support	%40	72,009
Fringe benefits	Rates vary from 21% to 29%	%10	18,412
Supplies, materials, non-expendable property	Supplies including software and misc computer hardware	%3	4,633
Operations & maintenance	Internet, local, and long distance phones, software licenses, equipment repairs and insurance	%8	14,340
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Enterprise 4000 server for DART	%17	30,000
NEPA costs		%0	
Construction-related support		%0	
PIT tags	# of tags:	%0	
Travel		%1	1,000

Indirect costs		%16	28,702
Subcontractor		%0	
Other	Lease	%6	10,904
TOTAL BPA FY2000 BUDGET REQUEST			\$180,000

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount (\$)
Corps of Engineers	Primary source for online inseason and historical hydro operations data and administrative record of Technical Management Team	%0	
Corps of Engineers	Contracts complement this project to retain staff full time and effectively reduce project cost.	%0	
		%0	
		%0	
Total project cost (including BPA portion)			\$180,000

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	\$150,000	\$150,000	\$150,000	\$150,000

Section 6. References

Watershed?	Reference
<input type="checkbox"/>	Scheibe et al. 1997. Development of a Network-Based Information Infrastructure for Fisheries and Hydropower Information in the Columbia River Basin. Final Report to BPA for Project 92-071, Contract WA179-86BP62611 - Task 24. Pacific NW National Lab
<input type="checkbox"/>	OMB 1992. Policy Letter on Inherently Governmental Functions. Office of Management and Budget. Federal Register publication 57 FR 45096 September 30, 1992.
<input type="checkbox"/>	Executive Order 13011
<input type="checkbox"/>	MOA 1996. Memorandum of Agreement among the Department[s of Army, Commerce, Energy, and Interior] concerning the Bonneville Power Administration's Financial Commitment for Columbia Basin Fish and Wildlife Costs. September 1996.
<input type="checkbox"/>	ISRP 1998. Review of the Columbia River Basin Fish and Wildlife Program for Fiscal Year 1999 as Directed by the 1996 Amendment to the Northwest Power Act. Report ISRP 98-1 for the Northwest Power Planning Council. June 15, 1998.
<input type="checkbox"/>	CBFWA 1998. Letter to Director, Fish and Wildlife Division, BPA. June 2, 1998.

PART II - NARRATIVE

Section 7. Abstract

The Fish and Wildlife Program (FWP) repeatedly cites the need to use the “best available information” and “adaptive management” in recovery efforts based upon effective monitoring

and evaluation. Primary data centers (Corps of Engineers, Fish Passage Center, StreamNet, and others) separately provide a variety of high-quality fishery, hydraulic, project-operation, and other observations but the integration of their integration into products for effective monitoring and evaluation has been limited. Contributing factors include the lack of co-location, diversity of data access protocols and data formats, lack of planned and coordinated development of regional information systems for inseason and long-term efforts, and a lack of support for development of monitoring and evaluation products for inseason and long-term efforts.

This project continues as a prototype for improving the integration and delivery of environmental and programmatic information to FWP and ESA participants and the greater Public. It sets an example that begs adaptation to other FWP information services. Using internet-based technology proven since 1995, the separate primary providers are polled automatically and subsets of their current-year data stores are integrated into this contract's local database, collectively known as DART (Data Access in Real Time). Data exchange agreements between the involved parties assure timeliness and content. Historical data is also incorporated to extend DART's temporal span. Specific data extracts and reports are automatically generated for use by identified FWP participants and other customers, saving them time and expense.

This project also provides an intuitive and highly flexible World-Wide-Web based interface for public access to the integrated database. This service facilitates user-customized graphic or tabular reports of multiple parameters over multiple years, encouraging the user to investigate relationships, to ask "What if ...", and to explore issues pertinent to adaptive management. This project provides equal public access to a broad range of historical and near real-time fishery, environmental, and operational information and the tools with which to independently and efficiently investigate cause and effect.

BPA believes that these efforts are necessary to provide BPA and regional resource managers appropriate analytical tools, timely access to essential information, and a sufficient breadth of information resources with which to make sound and independent economic, cultural, and scientific decisions.

Section 8. Project description

a. Technical and/or scientific background

This project is one means by which BPA is restructuring governmental services under Executive Order 13011 - "Federal Information Technology" - to provide public access to environmental information and effective information tools to decision makers. In general, these projects include efforts that generate useful new data, provide or improve access to new and pre-existing information at diverse levels of integration, and develop new or more effective methods of analysis and/or presentation. The objective of these efforts is to provide the information and analytical tools needed by front-line decision makers to make informed decisions, monitor consequences, and adapt management actions to changing conditions. Despite clear success in prototyping these efforts, FWP information managers have resisted incorporating the approach, technology, and services.

Despite improvements in data quality and access provided independently by the FPC, StreamNet, and other regional primary data providers, the FWP still lacks:

1. A clearly-defined means by which regionally-distributed (online) information can cost-efficiently be integrated for participants, and
2. A clearly-identified means of integrating critical portions of such online information

into products that characterize the ecosystem and are useful to monitoring, evaluation, and adaptive management.

Since 1995, this project (as part of BPA Project 8910800 - Columbia River Salmon Passage Model, CRiSP) and BPA Project 9207104 (Network-Based World-Wide Web Information Infrastructure [now operated by the Corps of Engineers for the Technical Management Team]) have been BPA's prototype solutions to the above needs. This project has provided a unique single-point source for FWP participants needing integrated information from more than one primary data provider, reducing participant "soft costs" associated with information acquisition and increasing FWP cost effectiveness. Project 9207104 continues to provide "third tier" services that integrates regional information for management analysis and support of operational decisions. These prototypes have been underwritten by BPA as part of its responsibilities under the Executive Order, the Endangered Species Act, and the Power Act.

As the federal party responsible for funding and cost-effectively implementing FCRPS fish and wildlife mitigation and ESA recovery efforts, BPA has certain intrinsic governmental responsibilities (OMB 1992) that may not be voided or transferred to other entities, including consensus processes such as the regional prioritization process. Chief among these responsibilities is preservation of the federal agency's ability to independently make decisions that commit fiscal and material federal resources. This ability is embodied in certain internal and external contracted activities, including this proposal, that provide information and support necessary for the agency to carry out consultations and operations in an independent and responsible manner consistent with the requirements of the ESA and the Power Act. The information management services provided assist the development of issues, data, and analytical tools that may not be approved in consensus processes but are that which BPA believes necessary for complete and independent consideration of alternatives and actions..

BPA recognizes that reservation of authority and funds for BPA's non-discretionary projects may be misconstrued. However, it is BPA's position that these efforts are necessary under BPA's responsibilities outlined above to provide BPA and regional resource managers appropriate analytical tools, timely access to essential information, and a sufficient breadth of information resources with which to make sound and independent economic, cultural, and scientific decisions. Moreover, BPA does submit these non-discretionary proposals to the same regional review process as all other projects and expects both BPA and the region to hold them to a higher standard for definition, implementation, and evaluation.

b. Rationale and significance to Regional Programs

The FWP regional prioritization is an evolving process that reflects diverse views as to roles and responsibilities "consistent with applicable law", as required by the 1996 Memorandum of Agreement (MOA 1996). From BPA's perspective, the annual prioritization must, among other requirements, not compromise BPA's ability to make independent decisions committing federal fiscal and natural resources. A critical requirement for independent decisions is timely access to a sufficiently-broad array of information without bias or that provides equal voice to all perspectives. This project provides both an example of such a resource. Whether it is free of bias depends upon perspective.

The services provided are critical to BPA's independent decision making ability with respect to annual operation of the Federal Columbia River Power System (FCRPS) under provisions of the Endangered Species Act (ESA) and the Power Act. This project provides data management services essential to forecasts and analyses BPA considers essential. It also provides equal access

to a broad range of information pertinent to planning, execution, and evaluation of FWP projects. Finally, this project is one means by which BPA is responding to Administration efforts to deliver environmental information, decision tools, and government services to the Public.

Of particular relevance to FWP participants are the Report Generator and Proposal Tool prototype services. The Report Generator allows a user to select one or more routinely-prepared documents, graphs, ect. for viewing and, perhaps printing, as a single package. The separate items can reside anywhere on the Internet. Such a tool can be used to integrate information within a single project or to provide integration of documents at any level of FWP administration, including the assembly of documents for upcoming meetings by the Council or any contract coordination.

The Proposal Tool employs a form-based interface that allows users to enter proposals and comments in an online discussion of issues. Employment of such a tool could provide an exchange of views, information, and ideas throughout the region, and certainly prior to meeting addressing issues of regional interest. Again, this tool could be implemented on a project or any higher administrative or technical level where interactive dialog is desired. Both tools improve access, review, monitoring, and evaluation. It was anticipated that some or all of the prototyped services would be adopted by one or more of the responsible primary data servers in the implementation phase of Internet-based TMT services. To date, only the Corps of Engineers has taken such action, having adopted in 1997 the entire services provided under the now-defunct project 9207104.

The FWP repeatedly cites the need to use the “best available information” and effective monitoring and evaluation to support adaptive management of recovery efforts. In practice, and until the recent explosion of World Wide Web use, this information standard was handicapped by limited public awareness of what data was available and how to obtain it, by the limited amount of relevant data actually online, and by “soft costs” associated with time delays in obtaining and integrating information from different providers. What was “best” and “available” was reduced to what was practical, possible, and affordable. With the National Information Infrastructure Initiative (now known as “Access America”), federal standards of “availability” have increased, requiring improvements in federally-funded information management, including the FWP. This proposal continues the development and demonstration of certain improvements with the expectation that appropriate improvements will be adopted by service providers.

The improvements to be realized include reduction of the “soft costs” FWP participants and inseason operations managers pay in obtaining and integrating fishery, environmental, hydrologic, and operational information necessary for planning, execution, monitoring, and evaluating purposes. The FWP identifies StreamNet (a.k.a. CIS, the Coordinated Information System) as the archive or regional database for FWP information. The StreamNet Steering Committee, comprised of federal, state, and tribal representatives, has directed the development of that archive towards issues other than inseason mainstem hydrosystem operation support. The FWP also identifies the Fish Passage Center (FPC) as responsible for the design of the inseason smolt monitoring FWP. The FPC, over time, has also assumed the role of inseason data manager and archive, including information from the Corps of Engineers. FPC provides a large amount of online quantitative information pertinent to the current year’s inriver research and decisions affecting operation of the hydrosystem. Archived information from prior years is not available online, either from FPC or from StreamNet and FPC’s “paper image” format of current data reports perpetuates the “soft costs” of information reformatting. Improvements in information infrastructure have been impeded by a lack of coordination between StreamNet and FPC, by the lack of data archive standards, and by funding limitations under the MOA. In the time-honored tradition, individual researchers and the various federal, state, and tribal participants continue to

maintain their own local mission- or topic-specific information “archives”. Consequently, the Public citizen or FWP participant needing information provided by these entities continues to face substantial “soft costs”.

The FWP also repeatedly cites the need for effective monitoring and evaluation to support adaptive management of recovery efforts. Unfortunately, there is little or no framework that defines what these requirements are or how they are to be implemented. This proposal provides a medium (the Internet) and prototyped mechanisms by which available online information can be integrated into sound monitoring and reporting products that may characterize the ecosystem and provide for adaptive management of recovery efforts. BPA’s Projects 8910800 (UW Web services) and 9207104 (currently the Corps of Engineer’s Technical Management Team Web Page) are prototypes in which diverse and regionally-distributed hydraulic, fishery, operational, and administrative information is integrated to provide interactive and automatically-prepared measures of performance, means of comparison and evaluation, and records of consequent management actions. Analogous online systems can be developed cooperatively between interested participants under Council direction to characterize ecosystem conditions and develop a sound monitoring and evaluation infrastructure.

c. Relationships to other projects

This project is one means by which BPA is restructuring governmental services under Executive Order 13011 - "Federal Information Technology" - to provide public access to environmental information and effective information tools to decision makers. Within the FWP, these functions are embodied in the Fish Passage Center implementation of the smolt monitoring program and support of Anadromous Fish Managers (AFM) decisions and in StreamNet’s information management role and support of Council decisions. Aspects of these services also contribute to inseason FCRPS operational decisions. The work proposed herein and embodied in the UW service Data Access in Real Time (DART) (and in systems supporting the Technical Management Team) compliments these FWP projects by providing working examples of how to more effectively employ technology in what are fundamentally government services supporting the FWP and operation of the FCRPS.

Reducing roles to their absolute minimum, FWP projects have focused on the primary roles of collection and quality control with some targeted application of information. For understandable reasons, these projects have been conservative in their approach to use of the World Wide Web. In contrast, this project is intended to explore and demonstrate the potential of the new medium and its developing set of information management, access, and delivery tools. In doing so, the prototype may well appear to “duplicate” aspects of the FWP projects. This is as incidental as is “duplication” between a pocket dictionary and the Multi-media Encyclopedia Britannica.

Simple statistics demonstrate the utility of DART. Web server access logs from Columbia Basin Research's web server contain detailed records of access to individual pages or products and limited information about the user. During the period January-November 1998, users used DART’s interactive database query form interface to generate 122,169 (11,100 monthly average) queries concerning adult migrants, juvenile (ESU) migrants, river conditions, and project operations. Based upon the suffix of their Internet service provider, government, military, and educational users respectively requested 6%, 17%, and 5% of the queries. The majority of users have unknown affiliation. From these queries, 51,539 (4,685 monthly) graphic products were generated, typically overlaying time series of various parameters. Each product is generated in a matter of minutes to the specification of the user. The remainder of the queries generated 70,630 (6,421 monthly) data tables that could be saved and analyzed locally by the user. Such services

and products are not available elsewhere from online services. An additional 87,834 HTML pages (7,984 monthly average) were also served with the same users respectively requesting 8%, 1%, and 8%.

Columbia Basin Research also provides web service for inseason forecasts of dissolved gas, water temperature, and juvenile salmon migration timing and survival through the FCRPS and Mid-Columbia projects. Query services generated 6,283(571 monthly average) graphical and tabular products pertaining to dissolved gas, water temperature, and juvenile passage. In addition, 8,811 related text pages (801 month average) were also accessed. Government, military, and educational users respectively requested 23%, 3%, and 13% of the graphic products and 7%, 1%, and 12% of text products. The majority of users again have unknown associations.

The intent of the work in this proposal is not to subvert or replace FWP information management efforts but to demonstrate ways to enhance their service to the public and FWP participants. Unfortunately, there is little planned or coordinated development of regional information systems (except within StreamNet, which does not address inseason information) and there is no present means to collaboratively address “improvements” to FWP information management. The ISRP recognized symptoms of these characteristics when they observed that FY99 proposals contained inadequate justification for the multiple databases involved under the smolt monitoring program and, in general, failed to demonstrate “how the vast amount of information acquired through the FWP is used to improve the program”. These shortcomings can be addressed through Council and ISRP assisted definition of FWP information requirements, service standards, and protocols for improving services.

This project also provides critical database service and Internet support to other non-discretionary projects that satisfy BPA’s responsibilities under ESA. Input data files are generated from DART’s database daily and weekly during the juvenile salmon migration for use in models that forecast migration timing (9105100) and survival (8910800) through the FCRPS. Model results are posted for viewing via the World Wide Web in support of FCRPS operational decisions. Similar database and Web support is provided to PATH (9600600) and specific investigations to improve study designs and statistical methods employed in recovery efforts. A significant portion of this support is dynamic, involving timely adjustment of services to meet changing requirements. These services could be provided through FWP projects if historical prejudices are overcome, appropriate coordination and technology implemented, and response to changing requirements demonstrated.

d. Project history (for ongoing projects)

During 1995, use of the Internet in support of Technical Management Team (TMT) information management was prototyped and demonstrated as parts of BPA Projects 8910800 (CriSP [University of Washington]) and 9207104 (Network-Based World-Wide Web Information Infrastructure [Battelle’s Pacific Northwest Laboratory]). Products and services were demonstrated and used during each TMT meeting.

The UW project demonstrated the feasibility and benefits of automating collection of information from regionally-distributed primary or first-tier databases (FPC, Corps, BPA, PITAGIS, USGS, etc.) into a single second-tier database accessible through the World Wide Web. These services (<http://www.cqs.washington.edu/dart/dart.html>) continue to

- provide access to complete year-to-date time series available only in single-day or several-day moving windows at primary sites,

- ❑ permit simple, quick access to cross-tabulations and graphics combining information distributed regionally on separate databases,
- ❑ reduce Web-based and other user impacts on primary sites whose resources are dedicated to data collection and quality control, and
- ❑ provide a test bed for development of improved services while avoiding impacts to primary data sites and support staff.

The Battelle project demonstrated the utility of a “third-tier” data service, one devoted purely to “value-added” integration and presentation of information available elsewhere on the Internet. This project demonstrated how quality online data could be integrated into highly-informative, condensed, graphical presentations or reports with minimal human effort. A plethora of products were automatically regenerated nightly with only an hour a week or less of system administration checking for data problems. See Scheibe (1998) and <http://www.nwd-wc.usace.army.mil/TMT/>

On January 26, 1996, BPA submitted to the TMT a proposal for administrative support that included commitment to use the World Wide Web. The Fish Passage Center manager objected to the entire proposal on the grounds that the TMT was considering proposals for funding outside the Council/CBFWA/BPA prioritization process. Certain environmental group representatives focused on cost estimates. Ultimately, the TMT agreed to study the issue further. Without formal endorsement, development and demonstration of TMT World Wide Web services continued through support from BPA's Office of the Environment as demonstration prototypes within BPA's response to the Vice President's National Information Infrastructure initiative. Demonstration of these services continued to be made during each TMT meeting and online information constituting an electronic administrative record of the forum.

On September 16, 1996 the Departments of Energy, Defence, Interior, and Commerce signed the federal Memorandum of Agreement (MOA) that defined BPA's budgetary commitments for the 1996-2000 period. While limiting total expenditures, it was expected to be sufficient to meet BPA's fish and wildlife responsibilities during that period.

The annual FY97 Fish and Wildlife Program did not include explicit funding for Internet-based information services though both StreamNet and FPC implemented limited web-based services. StreamNet focused on a CD-ROM based information distribution system. FPC included "paper images" of their weekly report and System Operation Requests on the FPC home page. To encourage further progress, BPA submitted a proposal to the StreamNet Steering Committee on August 22, 1996, requesting the Committee consider adopting all or part of the prototyped services. The Committee agreed to include in the FY97 work plan a review of the issue and to produce a recommendation. Subsequent politics, turf protection, etc. prevented the review and no recommendation was made. Funding for the DART services was continued under BPA's non-discretionary funding authority while the Corps adopted the third-tier Battelle services. Informal coordination with NMFS resulted in modification of both services as additional species were involved in ESA processes and as NMFS personnel obtained access to the Internet.

On June 3, 1997, the Northwest Power Planning Council questioned the possible redundancy of DART and the analysis on the Fish Passage Center's (FPC) Web pages. On July 30, 1997, BPA submitted to the Council a University of Washington prepared document comparing the several systems that constitute the region's information infrastructure for anadromous fish. The review document is available at: <http://www.efw.bpa.gov/Environment/EW/SUBJECTS/Framework/Data/DARTvsFPC/welcome.html>

The comparison illustrates the contrasting functions of primary and secondary services. The function of "second-tier" data management services, like DART, is integration, synthesis, and addition of informational value. DART does not provide analysis of information except as the user interacts to select time series and other constraints on the information to be presented graphically or in tables. Primary data services (FPC, Corps, PTAGIS) traditionally focus on raw data collection, quality control, limited processing, and presentation in selected formats to cooperating entities. Integration with data from other primary providers is generally left to the user. The second-tier service increases the value of the several primary services by providing a single consistent interface to both primary data (hence the appearance of duplication) and to integrated products that convey more information collectively than separately. The "duplication" is incidental to producing the integrated products

In May 1998, the DART data manager informally queried the Fish Passage Center manager regarding the possibility of transferring DART to the FPC. No progress was made.

The FY99 regional prioritization repeated CBFWA rejection of the second-tier proposal. CBFWA commented that the Anadromous Fish Managers (AFM) *"believe that project 9601900 potentially duplicates efforts of the Fish Passage Center and StreamNet, and that the specific products of such a proposal should be developed by all the involved entities"*. BPA welcomes that perspective if it represents a shift in previous AFM opposition to transfer of technology and Fish Passage Center refusal to engage in coordinated planning and development of regional internet-based information services.

While it is BPA's opinion that the second-tier service is an essential element in regional information management, BPA has reiterated at every opportunity that it must complement and cannot replace services of primary providers. Coordination between the primary and secondary providers could provide cooperative and effective service to the region. The comparison can serve as a starting point from which the Council could pursue constructive coordination between all interested parties. Such a development would compliment the developing Regional Framework.

CBFWA further indicated that the *"AFM understand that the same products can potentially be developed largely from the existing geographically-distributed databases on the InterNet"*. They are correct and echo BPA statements concerning future possibilities. However, current telecommunication capacity and performance is inadequate and data management infrastructure is inconsistent. Coordination and planning amongst the regional information services will ultimately achieve this goal. Until such time, second tier data services such as DART provide benefit to all users, including the AFM and CBFWA.

We encourage the AFM and CBFWA to consider the "product" or value of this service as not a "thing" but rather as a quality of access to information that has not previously been available. Of course, the service can be used to generate a table of project flows and dissolved gas observations that "duplicates" part of a Fish Passage Center weekly report. In like fashion, newspapers report the same basic news. It is the expansion on or integration of other news and issues that adds value to a given newspaper or report and which gives the reader greater understanding of context and issue. Likewise, it is the ability of this project's interactive service to selectively merge and present environmental, operational, and fishery information that sets it apart. Direct access to current and historic environmental information and the ability to inspect relationships offers opportunities for better understanding and improved management decisions

Also for FY99, the Independent Scientific Review Panel (ISRP 1998) reviewed the second-tier proposal, finding it scientifically adequate and giving it "moderate support" from the perspective

of the FWP. The ISRP observed that the "*proposal does not clarify why the problems inherent in the primary databases are not fixed instead of adding a second tier*".

Response: The proposal states (Section 6 Abstract) that the "Corps of Engineers, Fish Passage Center, StreamNet, and other primary data centers separately provide a variety of high-quality fishery, hydraulic, project-operation, and other data but the integration of that information into useful products is essential for effective monitoring and evaluation. Lack of co-location and a diversity of data access protocols and data formats complicates and increases the costs of data integration needed by many efforts funded by the FWP or required under ESA". Two problems were unstated. First is a lack of planned and coordinated development of the regional information system. Second is a lack of support for the integration of primary observations for planning, monitoring, and evaluation in general and for hydrosystem operations and their impacts in specific. Project 9601900 attempts to provide integration of diverse and physically-separated information into products that facilitate and monitor resource management efforts.

The ISRP recognizes part of the first problem in identifying (pg. 33) an inadequacy in justification of multiple databases associated with smolt monitoring. The ISRP also recognized (pg. 90) a lack of demonstration of "how the vast amount of information acquired each through the FWP is used to improve the program". These two criticisms apply generally to regional information management, not just to smolt monitoring.

The ISRP recommended (pg. 33) a review focused on three separate components of information management - data collection, data storage and retrieval, and data analysis. Such a review will need to provide for effective and flexible monitoring and evaluation which are candidates for second-tier implementation.

The second unstated problem - lack of support for integration for monitoring and evaluation - is a consequence of the first - lack of coordinated development. The StreamNet, FPC, Corps, UW and other regional information services have developed separately and primarily to serve the interests of the host agent - respectively the Council, the states and tribes, the Corps, and BPA. Despite best efforts, suspicions persist that the political interests of the host bias the available information, either in content, analysis, or presentation. These suspicions need to be addressed in the ISRP recommended information management review.

Project 9601900 is itself the consequence of regional resistance to BPA efforts to improve public access to FWP and operational information. Resistance is couched in fiscal arguments or in territorial statements about "duplication". What Project 9601900 provides is equal public access to a broad range of historical and near real-time fishery, environmental, and operational information and the tools with which to independently and efficiently investigate cause and effect. An actual example illustrates its utility. During TMT meetings, discussions during summer focus on current water temperature and flows as important determinants of late summer juvenile migrant survival. Comparison to prior years migration patterns, flows, and temperatures can quickly and easily be prepared through DART with presentation in graphic form for visual comparison and discussion. Patterns, trends, and future possibilities can be recognized. The tabular data can also be saved and analyzed locally. This process takes only a few minutes, an appropriate time scale for the decisions being made. Such production is not practical using other regional information resources which present static "paper images" of reports and which do not provide access to corresponding information for more than the current year. This capability would seem to apply to all FWP efforts that address cause and effect relationships.

The proposal did not address implementing the services under the Corps of Engineers or BPA's own data services without cost impact to the FWP direct program. To do so does not satisfy federal responsibilities under Executive Order 13011 and the need for this generic capability for all FWP efforts addressing cause and effect relationships. However, such an arrangement should be considered during the recommended reviews.

The ISRP also observed that the *"work is not so much collaborative as competitive, but this is all laid out and stated in terms of the need to cooperate. This project seems to be the result of frustration with other projects not doing what was expected"*.

Response: There is a great deal of "history" that has resulted in estrangement of parties that need to work cooperatively and synergistically. Rather than focus on such history, the region needs Council and ISRP assistance in reorienting and integrating our constructive efforts to better serve adaptive management and species at risk. BPA is prepared to participate in cooperative efforts that meet its obligations under Executive Order 13011, ESA, the FWP, and other obligations.

Historical costs of the combined prototype projects are as follows.

UW's BPA Project 8910800 (CRiSP)

1995: \$80,000

1996: \$50,000

1997: \$60,000

1998: \$198,000 budgeted for potential competitive contract; \$100,861 accrued. (Implemented as part of Project 8610800 for cost savings. Contracts between the Corps of Engineers and NMFS provided complimentary funding support that permitted full time employment of critical personnel and an effective reduction of project costs.)

Battelle's Pacific Northwest Laboratory's BPA Project 9207104 (Network-Based World-Wide Web Information Infrastructure)

1995: \$50,000

1996: \$85,000

e. Proposal objectives

1. Implement 95BO RPA 13 (Comprehensive monitoring, evaluation, and research program) in a manner that effectively integrates regionally-distributed online information into monitoring and evaluation products and services that support adaptive management and provide access to data and analytical tools permitting independent evaluation of issues and decision support for **inseason** operational decisions. Encourage improved FWP information management services through incorporation of prototyped tools and services. Provide data management and web support to independent analyses that inform BPA management and inseason management participants of inseason conditions and alternative actions. Continue development of improved methods of accessing and displaying regional information to assist all inseason management participants.
2. Implement 95BO RPA 13 (Comprehensive monitoring, evaluation, and research program) in a manner that effectively integrates regionally-distributed online information into monitoring and evaluation products and services that support adaptive management and provide access to data and analytical tools permitting independent evaluation of issues and decision support for **long term** planning. Provide data management and web support to independent evaluations of consensus PATH work products. Provide data management and web support for the development of PATH work products that are not addressed in the consensus process but which BPA believes necessary for responsible decisions.

3. Restructure governmental services (including work performed under contract) to provide public access to environmental information and effective information tools to decision makers (Executive Order Order 13011 - "Federal Information Technology"). Support development of World Wide Web based information services and their incorporation by technical and political processes involving federal resources and decisions.

f. Methods

The objectives of this proposal will be achieved if parties responsible for monitoring and evaluating inseason and long-term planning actions are able to locate and integrate information that permits a timely assessment of the effects of the actions and adaptation of management practices for better affect. The fundamental approach employed in DART and TMT prototypes is to combine proven approaches to information management with novel, customizable, and user-friendly means of access, integration, and presentation. The technology and methods employed may be divided into three major components: 1) the dynamic second-tier database, 2) interactive query and graphing interface services, and 3) the user connection.

The DART database is primarily a second-tier database since most of its content is obtained from other (primary) data sites. The DART data manager has established written or informal data exchange standards with primary providers. These standards address frequency of update, content and format of download, protocols for correction of errors, etc. Attribution to the source agency is provided to the user of DART.

DART is dynamic in that it automatically updates its contents for current (daily) information, including the regeneration of standard graphic and tabular products.

DART automatically accesses online resources of the Corps of Engineers, the FPC, USGS, and PSMFC and downloads fishery, river environment, and operational observations using industry standard file transfer protocols and newer internet-based methods including the script-based www command-line browser. Typical daily workload during the salmon migration period, April - August includes 50,000 records on water quality, 10,000 records on project data, 700-20,000 records on PIT-tags, and 100s of records on adult fish detections. The downloaded information is subjected to automated quality control checks, reduction from hourly to daily averages, if appropriate, and loaded into the Ingress database. These processes are scheduled to minimize impacts to users and contributing systems.

User access is strictly through the World Wide Web to take advantage of the "universal" user-oriented viewer (web browser) and information access toolsets. The interface is intentionally generalized to forms that allow the user to select parameters and periods of interest. The interface also allows the user to select tabular or graphic products and to customize the appearance of the results within limits. The query is processed by server-based perl and shell scripts to retrieve data from the Ingress database, possibly employ a graphic engine such as gnuplot, and return the result through the browser. Response time is only a few minutes, at most. Through DART, the user is able to examine the relationship between parameters and through time, e.g. flow and fish counts during a single year or for multiple years. This is not possible using other regional services.

Aspects limiting the potential of this application are social and technical. Social limits are the consequence of political and "professional" feuds of the past that prevent a synergistic relationship between StreamNet, the FPC, and other information systems, including DART. These limitations can be overcome through involvement of the Council and the ISRP and formal coordination of services. Barriers can also be broken down through the proven ability of the database administrator and web programmer to constructively interact with peers. Further

reduction of barriers will occur as additional parties "buy-in" to the service and engage in the dialog for responsive and evolving services.

Technical limitations typically boil down to the reality that internet connections are not universally fast, stable, or even available. This is particularly true in remote areas, including tribal lands. This is not an insoluble problem if the region commits to assuring the universality of service. BPA has and continues to investigate means of providing high speed data links to reservation and other remote lands in which BPA facilities are located.

g. Facilities and equipment

The current UW computer and database system is comprised of SUN UNIX workstations, including a 20 gigabyte online storage capacity and a T1 communication line for ethernet access to the Internet. IBM-compatible personal computers are also used for development and testing of Web products.

The Unix operating system and various common "open-system" software tools comprise the DART "machinery" that connects the database to external resources. These tools are the "essential organs" of these prototypes and may not be available under other operating regimes. For example, the automated data polling process is set in motion at specified times (when Internet traffic is low) by the Unix cron demon. Cron is a software tool that uses the computer's internal clock to schedule FWP execution according to a user-controlled scheduling plan (the cron table). The update process itself is implemented using shell scripts and makefiles. Make is a Unix-based utility that checks dependencies of specified files, and executes commands to update any files that are determined to be out-of-date. FTP or command-line web browser (i.e. a non-interactive WWW access tool) is used to automatically download specified datafiles from the provider. If the downloaded datafiles contain new data (as determined from the dependencies in the makefile), a series of Perl and Unix shell scripts are executed to process the data into the local database and into graphical or tabular products and moved to the Web server directory tree for public viewing.

h. Budget

Salaries: \$72,009

Anderson (0.4 month)
Cress (6 months)
Iltis (3 months)
Westhagen (2.5 months)
Van Holmes (3 months)
Kremlicka (3 months)
Muongchanh (0.3 month)

Benefits: \$18,412

Anderson (21%)
Cress (24%)
Iltis (24%)
Westhagen (24%)
Van Holmes (29%)
Kremlicka (29%)
Muongchanh (29%)

Services \$14,340 Phone services, including Internet,
software licenses/support,

	equip. repair and insurance, training
Supplies	\$4,633 Includes software and misc computer hardware
Capital acquisition	\$30,000 New Enterprise 4000 server
Lease	\$10,904
Travel	\$1,000
Indirect Costs (26%)	\$28,702

Total Costs	\$180,000

Cost sharing benefits accrue from concurrent and complementary contracts with the Corps of Engineers and NMFS that collectively provide full-time annual employment of critical staff. The Corps' contract provides \$86,000 of annual support to the Columbia Basin Research computer and DART facilities to conduct dissolved gas abatement research for the Walla Walla District.

Section 9. Key personnel

Curriculum Vitae

James J. Anderson

Columbia Basin Research

1325 – 4th Ave., Suite 1820

Seattle, WA 98101

Phone: 206-543-4772; Fax: 206-616-7452

Email: jim@fish.washington.edu

Associate Professor (WOT)

Fisheries Research Institute and Center for Quantitative Science in Forestry, Fisheries and Wildlife
College of Ocean and Fisheries Sciences

Teaching Activities:

Graduate course in modeling organism dynamics (QSCI 551)

Graduate course in Ecosystem models (QSCI 550)

Students Receiving Degrees: Three in M.S. Fisheries, Two in M.S. Quantitative Ecology & Resource Management, and Two in Ph.D. Quantitative Ecology & Resource Management.

Current Research Projects:

Bonneville Power Administration (Funding level: \$6+ million): Developing computer models for management of Columbia River hydroelectric and fisheries agencies.

U.S. Army Corps of Engineers (Funding level: \$1+ million): Developing analysis and computer models for the impact of gas bubble disease on migrating salmon.

National Marine Fisheries Service (Funding level: over \$500K):

- 1) Studying mortality processes of juvenile salmon in tributaries
- 2) Developing a multi-species multi-regional salmon harvest model

Honors and Awards:

- 1) Research Faculty Fellowship, College of Ocean and Fishery Sciences 1985, 1989.
- 2) Special Recognition for participation in the U. S. Fish and Wildlife Service Fish Passageways and Division Structures course in 1990.
- 3) Nomination for Computerworld Smithsonian Awards in programming for the CRiSP computer model College of Ocean and Fishery Sciences Distinguished Research Award,

1996.

Professional Activities: Consulting; Expert Testimony on Fish Migration and Dam Passage; Guest Speaker

Selected recent publications from over 45 publications and reports include:

Anderson, J.J. 1998 (in press). Decadal Climate and Declining Columbia River Salmon. Proceedings of the sustainable Fisheries Conference, Victoria B.C., Canada. Eric Knudsen, Editor. American Fisheries Society special publication no. 2x. Bethesda, MD.

Anderson, J.J. A vitality based model relating stressors and environmental properties to organism survival. Accepted by to Ecological Monographs in 1998.

Helu, S.L., J.J. Anderson, D.B. Sampson. 1998. An individual-based boat fishery model can generate fishery stability. Natural Resource Modeling. (In press)

Zabel, R.W., J.J. Anderson, and P.A. Shaw. 1998. A multiple reach model describing the migratory behavior of Snake River yearling chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences: 55:658-667.

Judith E. Cress

5451 44th Avenue S.W.

Seattle, WA 98136

Home phone: (206) 938-7660

Work phone: (206) 685-7972

Experience:

Research Consultant/Data Manager

Columbia Basin Research, University of Washington (1992-Present)

Coordinate and design Columbia River DART, a real time data warehouse for salmon research on the Wide World Web. Designed and built internal data design and automated access loading system. Coordinate with external organizations for data resources. Provide automated data support for Technical Management Team. Provide data support on salmon research projects for both in-house projects and external organizations.

Program Manager - PIT Tag Information System

Pacific States Marine Fisheries Commission (1990-1992)

Designed and implemented PTAGIS management information system under Bonneville Power Administration Contract. Managed all PIT Tag data acquisition sites at Columbia and Snake River Dams. Coordinated with ten man Inter-governmental working committee. Managed engineering and programming support staff and budgetary areas. Provided PTAGIS training to Federal, State and Tribal personnel.

Database Analyst

Automated Data Processing (1989-1990)

Designed and built automobile parts tracking system for Nissan auto parts. Worked in advanced research department.

Supervisor/ Database System Analyst
General Electric Government Services (1983-1989)
NASA-Ames Research Center, Sunnyvale, CA

Supervised software support department. Designed and implemented more than two dozen database management systems for life science research for Space Shuttle Life Science missions. Served as Ames Research Site Representative on Space Station Information System at Kennedy Space Center and Johnson Space Center. Member ground support team, Space Shuttle Discovery (1985).

Education:

B.S. Information System Management, University of San Francisco, 1985
Computer Science and Engineering, U.C. Berkeley 1983-1984
Project Management Certification, National Aeronautic and Space Administration, 1987
Project Management Training, General Electric Government Services, 1987

Susannah Lea Iltis

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EDUCATION

Master of Library Science (1995) Graduate School of Library and Information Science (accredited),
University of Washington, Seattle, WA.

Bachelor of Arts (1990) Pomona College, Claremont, CA – Concentration: English Literature.

PROFESSIONAL EXPERIENCE

Public Information Specialist (1994-present, 1.5 years graduate student) Columbia Basin Research (CBR),
School of Fisheries, University of Washington, Seattle, WA.

- Web coordination - responsible for managing and maintaining the CBR web site (averaging 8000-10,000 hits per week) which includes a real-time database, computer models, analysis tools, literature reference database, and research publications (www.cqs.washington.edu)
 - ◆ plan and implement web site redesign (July 1997), implement web site search engine, validate web site hypertext links on regular basis, design and create new web pages
 - ◆ prepare and convert word processing documents for dissemination on the WWW
 - ◆ search, analyze, and evaluate quality of information on WWW for selective dissemination
 - ◆ write online documentation and perform technical editing

- ◆ answer requests for information on variety of subjects
- Document coordination - responsible for the creation, design, and augmentation of the CBR Literature Database for the research project using the DBMS Ingres and WAIS (Wide Area Information System) -- currently over 1700 records on salmon, fisheries, oceanography, animal behavior, modeling, and statistics. URL: www.cqs.washington.edu/crisp/lit/
 - ◆ develop conceptual schema and design and test record formats
 - ◆ locate, acquire, and catalog documents
 - ◆ design, implement and maintain full-text, web accessible database using WAIS
- Puget Sound Regional Synthesis Model (PRISM) - participate in web development, implementation, and maintenance (www.prism.washington.edu)
- SalmonWeb - coordinate web development, GIS, programming, and database activities and disseminate information to the public (www.salmonweb.org)

OTHER WORK EXPERIENCE

Book Sales Associate (1990-present) University Bookstore, Bellevue, WA.

- ◆ perform excellent customer service and assess, research and fill customer's information needs
- ◆ pinpoint and solve difficult customer service problems with orders and stock

ORULS (Oregon Regional Union List of Serials) Assistant (1986-1990 part-time) Oregon State Library, Salem, OR.

- ◆ search and evaluate OCLC bibliographic records for comparison to the microfiche records
- ◆ convert microfiche records to OCLC and union list serial holdings (160 participant libraries)

Manuscript Reader and Publicity Intern (1990-1991) Seal Press, Seattle, WA.

- ◆ manuscript reader: read and evaluate submitted manuscripts, prepare recommendation reports and answer manuscript submission inquiries
- ◆ publicity: keep publicity review files current and assemble promotional kits and mailings

COMPUTER / INTERNET RELATED EXPERIENCE

Operating Systems: UNIX, Windows 95, Windows NT

DBMS / Databases: Ingres, BIP Plus, SilverPlatter databases, OCLC FirstSearch

Internet: WWW, WAIS, HTML, Netscape, Internet Explorer, gopher, telnet, ftp

Software: OpenWindows, MS Word, MS PowerPoint, MS Project, Adobe FrameMaker, Adobe Exchange, Quadralay WebWorks Publisher, Xview, Xpaint, Excite EWS, HyperNews, MapEdit, Wusage

Christopher Van Buren

EDUCATION

Cornell University. Ithaca, New York. Bachelor's degree in Biology 1980.

University of Chicago. Chicago, Illinois. Two years of graduate study in Evolution, Genetics and Development. 1982-1984

Currently enrolled in Information Science courses at the University of Washington as a non-matriculated student.

CURRENT RESPONSIBILITIES

Design, develop, and manage SalmonWeb database. Design and develop database-cgi program interfaces. Identify data needs and anomalies. Locate, retrieve, document and load data from public and private sources into databases. Analyze database systems and optimize database performance. Provide data support for research interests of group. Maintain and update data files for the CRiSP model. Calibrate CRiSP model parameters. Maintain Realtime model for in-season migration predictions.

QUALIFICATIONS

Four years experience in INGRES database management. Extensive experience with Unix, DOS and Macintosh operating systems. Proficiency in the following computer languages: Perl, SQL, QUEL, Bourne- and C-shell scripting, Sed, Awk, HTML.

Experience with the following applications: SPSS, Splus, Frame, WPublish, Arc-Info, Microsoft office including Access.

RECENT JOB COMPLETIONS

Designed developed and implemented data retrieval, classification and loading system for USACOE web-based water quality data. Optimized daily table updates for dissolved gas data. Designed tables and retrieved data for recaptured PIT-tagged fish dataset. Retrieved, filtered, and extrapolated spill, flow, temperature, gas, and elevation data for inclusion into CRiSP model.

RECENT EMPLOYMENT

Systems Analyst/Programmer II - current position at Columbia Basin Research, Center for Quantitative Sciences, School of Fisheries, University of Washington. 1995 - present

Assistant Database Manager - Fetal Alcohol and Drug Research Unit, Department of Psychiatry, School of Medicine, University of Washington. 1996-1997

Veterinary Records Assistant. Woodland Park Zoological Garden. 1995-1996

Section 10. Information/technology transfer

The intent of this project is to demonstrate the potential application of the Internet and World Wide Web in managing and accessing FWP and operational information. Unfortunately, the history of this project reflects certain institutional and social problems that limit the region's ability to engage this technology for the benefit of the FWP.

Congratulations!